

Engineering Management
Field Project

The Decline of Students Entering Engineering & Other Technical Fields in the United States

By

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Fall Semester 2006

An EMGT Field Project report submitted to the Engineering Management Program
and the Faculty of the Graduate School of The University of Kansas
in partial fulfillment of the requirements for the degree of
Master of Science.

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Acknowledgements

To my husband, Jason, who supported me throughout the EMGT program and supplied the ever so gentle pressure required for completion of my field project,
thank you and I love you.

Many thanks to my project committee chair Robert Zerwekh, and committee members Herb Tuttle, and Chick Keller for their assistance and encouragement in the completion of this paper.

I would also like to thank the students of Laporte Public School for performing the necessary role of completing the surveys; as well as Steve Booth, Andrew Sundberg, Wayne Buckley, and Nancy Erickson for taking the time to administer the survey to their students.

Executive Summary

The United States is nearing an engineering crisis. The need for technical professionals is growing rapidly and universities are unable to meet the demand due to declining enrollment. Students are coming out of high school with little or no interest in technical fields, and the ones that do show interest are often lacking the math and science background required.

Research has shown that a majority of students are not knowledgeable about engineering as a career option. Investigation is needed to learn how we can increase awareness of engineering and its value to the world. A pilot survey was developed and administered to students in both elementary and high school classes, to learn student opinions on the subject. Measures of the survey were as follows:

1) Student career aspirations. It was found that younger students often select careers which followed their parents' footsteps, while older students selected careers in fields where they showed talent.

2) Feelings toward school subjects, mathematics and science in particular. The most common reason given for enjoying a subject was that it was "fun;" opinions of math and science declined as students grew older and found the classes "boring".

3) General knowledge of engineering. Most students associated "engineering" to cars and trains via the word "engine," only 15% could correctly described the field.

This paper reviews already published writing on this issue, as well as development, administration, and results of the pilot survey.

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Chapter 1 – Introduction

According to current research, the number of engineering degrees awarded at the undergraduate level within the United States has been declining steadily over the past few decades when compared to the total number of degrees awarded. While this trend has been perpetuating, technology has been growing in leaps and bounds, resulting in a much higher demand for technical professionals. In order to fill the current gap, work visas and incentives are provided to foreign-born engineers to work in the U.S. However, with more opportunities being created internationally everyday, even this pipeline is at risk. Moreover, it is expected that an additional 1.25 million engineering and other scientific jobs will be created in the U.S. by the year 2012. Unless Americans makes some striking changes quickly, there will be a major crisis. The time to start tackling this troubling issue is now. (National Science Foundation “America’s Pressing Challenge – Building a Stronger Foundation” 2)

In 1975 the United States was third among 19 developed nations in producing students with baccalaureate degrees in science and engineering; by 1999 this ranking had dropped to fourteenth. The total number of students pursuing baccalaureate degrees in the U.S. has shown an increase in this same time period; it is only the technical fields that are showing a decline. (National Science Foundation “America’s Pressing Challenge – Building a Stronger Foundation” 1)

Just as upsetting as the student numbers is student performance. The National Science Board’s (NSB) *Commission on Precollege Education in Mathematics, Science and Technology* saw this problem coming nearly 25 years ago. A goal was set that U.S. student achievement would be “best in the world by 1995”. Sadly, by

the time most of today's students reach high school graduation they are performing not at the top as hoped, but nearly at rock bottom when compared internationally. (National Science Foundation "America's Pressing Challenge – Building a Stronger Foundation" 1) Where did the NSB go wrong on this goal?

Students in other nations are consistently showing superior performance in both mathematics and science courses by the time they are at junior high age. (Kosbar F2A-19) This proves that steps need to be taken while students are even younger. Attitudes and opinions on classroom subjects are created at a young age; students begin to lose interest between the 2nd and 4th grades. (Bottomley 2509) Unless teachers are able to peak the curiosity of students at the elementary school age and get them excited about technical courses, engineers will continue to find a major struggle in the years to come.

Research Objectives

This paper entails the details of a pilot student survey compared against the examination of existing research on the decline of the engineering profession. Discussion will focus on ideas from poor elementary and high school education to the unpleasant image most American children currently have of engineers. Specifically, the study described by this paper discusses the feelings students have toward their current mathematics and science courses, as well as their opinions and knowledge of engineering in general. Much of the discussion is spent on the way these feelings change as students get older and move from elementary into high school.

Surveys were administered at two levels of elementary school (3rd and 6th grades) and also at two levels of students in high school (9th and 12th grades). The

questions posed in the survey aim to learn the students' opinions on future careers, their general feelings toward science and mathematics, and their current knowledge of engineering as a career.

Chapter 2 – Literature Review

Current State

The number of science and engineering graduates steadily increases each year. Just looking at the numbers would indicate there is no shortage, and thus no problem. However, the numbers must be compared against the total number of degrees awarded and consideration must be given to the continual population increase. Since 1966, the number of science and engineering degrees awarded has increased from 184,313 to 400,206 in 2001. However, as a percentage of total degrees, science and engineering has decreased from 35.2% to 31.8%. (National Science Foundation “Science and Engineering Degrees: 1966-2001” 9) See Figure 1 below.

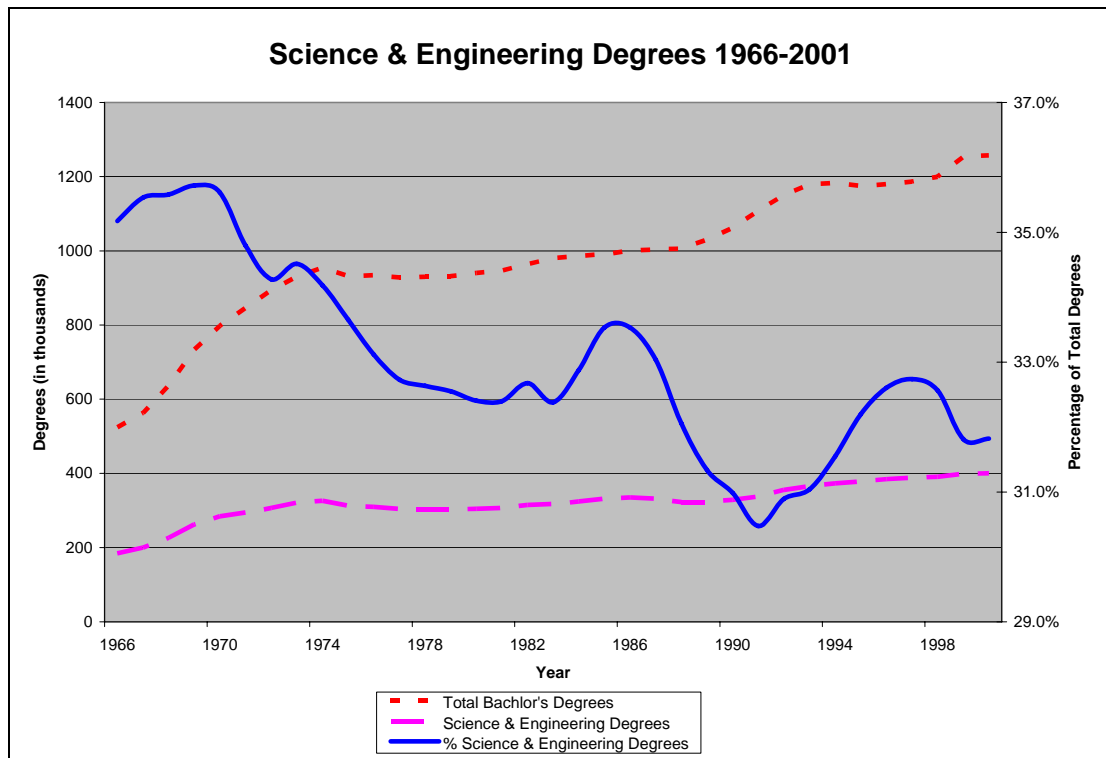


Figure 1: Percentage Science and Engineering Degrees to Total Degrees

Source: National Science Foundation, Science and Engineering Degrees: 1966-2001, March 2004

Within the total number of science and engineering degrees, the quantity that is in fact from engineering degrees alone shows this same trend. While the numbers in general have been increasing, the percentage of the total is going down. Of the total 284,230 science and engineering degrees awarded in 1966, 44,770 were in fact engineering degrees. This figure amounts to 6.8% of the total baccalaureate degrees awarded that year. Thirty-five years later, in 2001, of 400,206 science and engineering degrees awarded, only 59,258 (or 4.7% of total degrees awarded), were specifically in engineering. (National Science Foundation “Science and Engineering Degrees: 1966-2001” 13) See Figure 2 below.

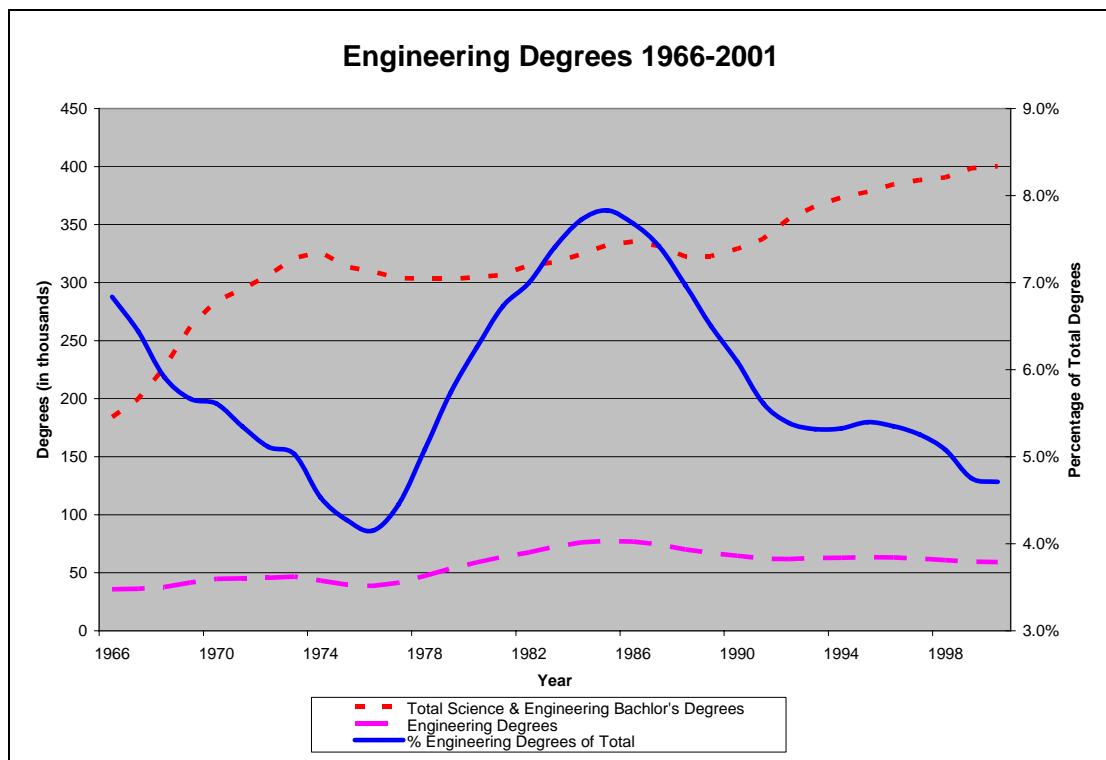


Figure 2: Percentage Engineering Degrees to Total Degrees

Source: National Science Foundation, Science and Engineering Degrees: 1966-2001, March 2004

While engineering degrees in the United States are hovering just under 5%, other countries are producing engineers in much greater numbers. Asia in particular

is growing rapidly and the output of engineers from that region is staggering. For instance, China produced 567,839 total degrees in 2000 (compared to 1.2 million in the U.S.). Of these half million degrees, 219,563 were awarded to engineering students, that is 38.7%. (Murray 67) See Table 1 for comparison of the U.S. to other countries.

The Chinese government has a goal for 50% of their college graduates to earn a degree in engineering. The focus of China on this goal is highly visible and easy to understand. All nine of the country's Politburo Standing Committee members are themselves engineers. (Murray 68) Compare this to the 535-member U.S. Congress, which has only six engineers, and it is easier to understand the difficulty of bringing this issue to a high level within this country. (Murray 74)

	University Degrees	Engineering Degrees	Percentage
China	567,839	219,563	38.7%
Taiwan	117,430	26,587	22.6%
Germany	178,618	36,319	20.3%
Japan	542,314	104,478	19.3%
France	275,316	34,293	12.4%
Ireland	18,669	2,014	10.8%
United Kingdom	274,440	20,280	7.4%
Kenya	15,620	740	4.7%
United States	1,253,121	59,536	4.7%

Table 1: U.S. Engineering Degrees Compared to other Nations

Source: Murray, Charles J., America's High-Tech Quandary, Design News 12.05.05

Growth in undergraduate engineering enrollment for North America when compared to other geographical areas, rather than individual countries, is better than only Eastern Europe. At just under 1% growth, North America is struggling to keep up. Both Asia and Oceania have grown over 30%, while Eastern Europe is the only

geographic region that saw a numerical decline in the 1990s. (Anderson 87) Figure 3 (below) graphically shows a comparison of engineering enrollment by geographic region.

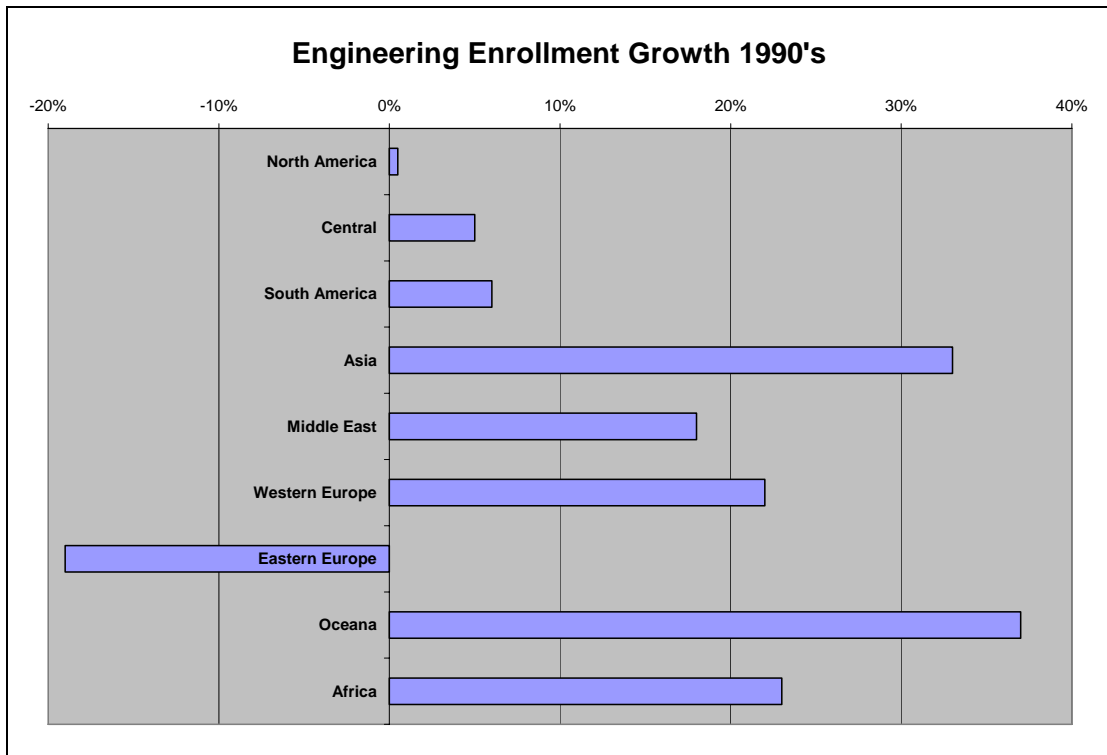


Figure 3: Growth in Undergraduate Engineering Enrollments

Source: Anderson & Gilbride, Pre-university Outreach: Encouraging Students to Consider Engineering Careers, 2003 UICEE

There are numerous suggested reasons for the weakening of the engineering profession in the United States. They can be broken into three main ideas.

1. Poor mathematics and science education at the elementary and high school levels.
2. Poor public image of engineering, misconceptions of the profession, and lack of excitement.
3. No introduction of engineering to students as a possible career choice.

Mathematics & Science Education

Young students are not gaining an aptitude or appreciation for the technical sciences through elementary and high school education. In fact, a majority of students show a growing disdain for the fields as they age. This is proven through poor performance by most U.S. students on standardized tests. Increasing this problem is the fact that most elementary and high school level teachers do not themselves have the appropriate instruction in order to introduce these subjects as enjoyable.

As discussed under the previous heading, academic performance of U.S. students has decreased drastically in comparisons with international students over the past few decades. Federal data shows that, of graduating high school seniors, only 17% are proficient in math and science. (Grossman 38) This performance reflects poorly on our nation's teachers, and rightfully so. Ronald F. Ferguson, a researcher from Harvard, has studied the relationship between the performance of teachers and the resulting achievement in their students. He found a positive correlation between teacher test scores on the Texas Examination of Current Administrators and Teachers (TECAT) and the scores of their students on the Iowa Test of Basic Skills (ITBS). Teachers with high TECAT scores are more likely to get higher achievement out of their students than teachers with lower scores. (Haycock 11)

Other research shows that teacher education plays another big part in student performance. Teachers who regularly teach in the field of their particular major achieve better student results; this is most evident in mathematics and science. Using data from the National Educational Longitudinal Study of 1988 (NELS), researchers

Goldhaber and Brewer concluded that “teacher subject-specific knowledge” is the most important factor in student achievement, specifically in technical subjects. (Haycock 12) Approximately 20% of high school science and math teachers in the U.S. do not have certification in the courses they are teaching. Most hold at least a baccalaureate degree, but may not have direct training in the subjects they are being asked to teach to their students. (National Science Foundation “America’s Pressing Challenge – Building a Stronger Foundation” 3)

While these studies go far in providing information on the decline of student performance as it relates to teaching ability, there have yet to be any further studies on what qualities “make for an effective teacher”. (Haycock 11)

In an attempt to rectify this problem, a number of U.S. states are beginning to raise the standards teachers must meet to get licensed and legally enter the teaching profession. New examinations have been added, and the older established exams are now more arduous. In addition, some states are putting restrictions on colleges and universities that do not produce quality teachers. For instance, Texas now requires at least 75% of graduating teachers to pass the state licensure exam. Any University that does not meet this requirement will lose their accreditation. (Haycock 21)

The new, and increasingly strict, rules in Texas are a great start to improving the education of all children in the U.S. In general, many of the college graduates going into the teaching field tend to have lower than average academic skills. Starting from high school, students with the desire to become teachers are, in most cases, less able academically and have lower SAT scores. (Haycock 24) This perpetuates into college as many teaching majors are not required to take the more

difficult academic courses that other majors require. (National Science Foundation “America’s Pressing Challenge – Building a Stronger Foundation” 3)

A paper written by Sheryl Sorby and Beverly Baartmans of Michigan Technological University provides a few new ideas to alleviate this problem with graduating teachers. In order to provide elementary and high school students the best teachers possible, especially in the math and science courses, Sorby and Baartmans suggest two directions. First, working with young teachers while they are still in college will help prepare them for successful teaching. Secondly, helping teachers currently in the workforce to better their understanding of the technical fields would enhance their ability to pass the information on to their students. They also make the suggestion of dual baccalaureate degrees in engineering and teaching. (Sorby 10358)

These ideas accomplish two things: The teachers will benefit from the education; and their students will benefit from the newfound knowledge. Professional development for teachers helps them to become more confident in their lesson plans. As teachers learn more about engineering and promote it through their math and science courses, the students will be learning about an exciting career path that they may have never before considered.

Public Image of Engineering

“Surveys show that children of engineers have a much higher likelihood of becoming engineers than those students without any personal connection to the field.” (Orsak 210) As most American children have never been exposed to engineering as a real career, it is understandable that they do not have any desire to join the discipline. A 1998 American Society for Engineering Education (ASEE) survey found that 45%

of the American public is not well informed on the engineering profession. Moreover, 53% of new college graduates do not feel as though they are knowledgeable or aware of what engineers actually do. (Yurtseven 20)

The numbers are even worse for students still in high school: 72% report that they do not feel they have a profound understanding of science, and are also unable to scientifically explain how and why things happen. A total of 68% of students surveyed do not see any connection between science classes they take year to year. (Kelly F2A25)

Engineers themselves are the best ambassadors for the profession. In a Design News editorial, Ray Almgren discussed the fact that engineers are “terrible at marketing”. He suggests that engineers need to get out into the public, and should advise students that engineering degrees are among “the most versatile degrees on the planet.” (Almgren 18)

To engineers, the word engineering is defined as the “application of math and science in the service of humanity.” (Higgins 48) This definition needs to be better promoted to the American public. The word *engineer* comes from the Latin word *ingeniator*, or ingenious. The soldiers and other army staff who designed and built bridges, and cleared roadways during the Roman Empire were titled *engineers* by the Romans, for their great minds. Later, with the invention of the steam engine and internal combustion engine, the English language forever linked the word *engine* with the word *engineer* rather than the original Latin word *ingeniator*. Thus began the decline of the image of engineers across America. (Yurtseven 17)

To this day popular culture does not promote engineers in a good light. From the *Dilbert* cartoon strip, where engineers are portrayed as “too bright for our own good...non communicative, dull, and loners” (Yurtseven 21), to recent movies like *The Aviator* where the lead character, an engineer, is “eccentric at best and anti-social at worst” the image portrayed is not a positive one. (Murray 72) American students absorb this information and start to believe the stereotypes. Negative stereotypes, as in *all engineers are nerds*, as well as positive stereotypes, in the vein of *engineers must be geniuses*, all combine to affect student choices. (Hirsh F2A-7)

Unlike the 1960s, there is no moon landing to excite the minds of young children and get them looking up to engineers. There is no longer any mystique to the profession of engineering. Instead, through the help of numerous television programs and blockbuster movies the engineering image has become almost laughable. Engineers are often seen as pocket protector wearing, calculator wielding misfits who are unable to communicate with the general public and wear their pants up to their chests. Sadly, teachers, parents, and counselors are unable to dispose of these myths as they themselves are largely unaware of the actual particulars of the engineering profession. (Murray 70)

There have been changes toward the positive in recent years. Like the 1980s TV shows, *The A-team* and *MacGuyver*, where engineers were shown as free-thinking problem solvers, newer TV shows are once again beginning to shed a positive light on the science and engineering fields. The popular *CSI* series, shown on the CBS network, has nearly on its own improved the image of forensic science, and university programs around the nation are now busting at the seams. Another

CBS show, *Numb3rs*, has been able to show real life applications of mathematics and how it can be used in new and exciting ways.

Engineering Outreach

In addition to national attempts at improving the image of engineers, students are also being introduced to the field through a number of new outreach programs. These programs are crucial for increasing engineering awareness at the elementary and high school levels. Research has proven that while knowledge about engineering is dwindling, involvement in engineering outreach programs can greatly increase student interest. (Anderson 92) As a result engineering outreach programs have been sprouting up all around the country.

The *GK-12 Teaching Fellows* program and the *Integrated Teaching and Learning* (ITL) program, both sponsored by the National Science Foundation, use current college engineering majors as mediums to pass engineering knowledge on to elementary and high school students. Engineering graduate and undergraduate students are matched up with current K-12 teachers and assist the teacher in presenting experiments and explaining the process and principles behind it. While the children are benefiting from knowledge and interaction, the engineering students are gaining priceless communication skills. A majority of students that choose to study engineering are visual learners. For this reason the Teaching Fellows and ITL programs use activities that are hands-on. Though not every child will enter engineering or another technical field, all students benefit from the science knowledge they gain through these programs. (Bottomley 2508; Schaefer 6586)

Another outreach program, this one based in Canada, uses a different strategy. The *Discover Engineering* program, developed by the Women in Engineering Committee at Ryerson University in Toronto, began in 1991. This program, like the Teaching Fellows program, uses hands-on learning techniques to provide insight to engineering principles. However, rather than using in-class participation, Discover Engineering offers a week-long summer camp for elementary age students, and provides after-school workshops for high school students. The aim of the program is to increase appreciation of the profession, and provide information on the availability of career opportunities. (Anderson 88)

A different avenue for providing engineering knowledge is used by *Project Lead the Way* (PLTW). This program, which was started in 1980s by Richard Blais, the Technology Department Chair in an upstate New York school district, develops and offers in-school classes on engineering. These are not individual lessons for teachers to add to their daily plans, or after school classes. These are real courses offered as part of standard curriculum by participating schools that aim to introduce engineering concepts to their students. PLTW is now offered by over 2000 school districts in 45 states. The teachers providing these courses are not substitute or associate teachers, but are the actual school district teachers. Each instructor is required to attend special training during the summer months to prepare. The goal of PLTW is to increase the number of students who select engineering as their future major for college, and to improve the education of all students in their classes. (Tsai B7; www.pltw.org)

Though each of these programs is structured in a different way, all are aimed at the same result.

- An increase in student awareness of engineering and the opportunities such a degree can provide.
- Interaction for children with actual engineers and engineering students to help lessen the negative image the profession current carries and expand ideas.
- Improved technical knowledge, including enhanced math and science skills, to reverse the trend of poor education rankings of the U.S.

Chapter 3 – Development of the Survey

To determine student feelings toward the sciences and perceptions of engineering, a survey was administered to students at four stages of elementary and high school. This was a pilot survey; the administered surveys had not been utilized prior to the study which is entailed in this paper. The following section of this paper will detail the creation, layout, and methods of the survey.

Measures

The first step of creating the pilot survey was determining what information was desired from it and where to find the needed data. Previous research has shown that any effort to direct students toward the sciences must be done at younger ages than was first believed. Students form early opinions on subjects that will remain with them throughout their educations. For this reason, the survey was presented to students at a number of different positions in their elementary and high school careers.

The foremost questions raised from the research, which the survey aimed to answer were:

- 1) What careers do students select for their possible futures; why do they choose these careers; and do their parents' careers affect their choices?
- 2) What courses do students like or dislike in their current curriculum, and why do they feel this way?

- 3) Why do a majority of students feel negatively toward math and science, and is there anything teachers could do to dispel these attitudes?
- 4) What level of knowledge do students have of engineering careers in general?
- 5) How do the answers change among the students as they get older?

Survey Format

The surveys were administered to students in only one school as a pilot study. Because of this a format was selected utilizing open-ended questions with ample area to write and provide personal responses. More detailed information was gained from these answers than could have been found in a closed-ended, multiple-choice style. Due to the lower number of respondents, a considerable amount of time could be spent on the review of each student's individual responses.

It is difficult to determine student knowledge on a generally unfamiliar topic like engineering without prompting or providing hints on the subject. Supplying these sorts of clues makes the after-survey review much easier, as all students get the exact same idea from the question and will answer along the same lines. However, prompting the students on questions or topics about which they may or may not know a great deal does not provide accurate information on the student's actual knowledge of the profession. Thus, the surveys administered in this study were provided with minimal prompts.

Method

Participants

The surveys were administered to students attending a small public school in rural north-central Minnesota, the home town of the author. The entire school hosts students from Kindergarten through high-school in one complex. The elementary school has approximately 145 children from K through 6th grade, while the high school has roughly 165 students in 7th through 12th grades.

In general, the school serves children from lower-middle to middle class families. The median income for a local family is \$33,987/year, the county median is \$42,122/year, and the state median is \$56,182. The school is located very near two area Indian Reservations; accordingly 12.5% of the elementary students and 23.8% of the high school students are of Native American heritage. A small percentage of students are of Latino origin: 3.5% in the elementary and 1.2% in the high school. The remaining students are Caucasian. (www.muninetguide.com)

	3 rd Grade	6 th Grade	9 th Grade	12 th Grade
Male	8	10	8	10
Female	8	11	13	11
Total	16	21	21	21

Table 2: Student Participation in the Pilot Survey

To learn how opinions change as students age, the surveys were administered to four different grade levels. The youngest students were in grade level 3. At this age the students are able to comprehend as they read and can adequately write their own thoughts onto the survey sheet. The second survey was administered to students in Grade 6; this is the last elementary grade in the subject school and the last chance

to obtain the opinions of students before they enter junior and senior high. In the high school, surveys were administered to the freshman (9th grade) and senior (12th grade) classes. At these ages the students are developing real plans for the future and making decisions about their planned careers. Table 2 (above) details the number of students who responded to each survey.

Materials

The surveys administered to each level of students were similar in style and tone of questions asked, but they were not identical. The younger students were asked fewer questions, and in much less detail. The older students were asked to formulate more opinions on the classes they had taken, and to give more detailed explanations. See Appendices A-D for copies of the administered surveys.

3rd & 6th Grade Surveys

The elementary classes were provided with much shorter surveys than the high school classes. The 3rd grade class was given the shortest version. This is due to the attention span of the students taking the survey; in order to get the best answers and keep them focused, the survey was developed as to not take a significant amount of class time.

The surveys began with questions regarding job and college aspirations, followed by an inquiry about their parents' careers. Next the students answered likes and dislikes concerning school subjects. Math and science questions were asked in particular. This is the only portion where the two elementary surveys differed. The 6th grade class was additionally asked

about in-class activities for math and science courses and the effect these had on the student. Lastly, the elementary students were asked questions concerning engineers, what they think engineers do, and whether or not they know anyone who is an engineer.

9th & 12th Grade Surveys

The high school surveys administered to the 9th and 12th grade classes were identical. They consisted of nearly double the number of questions as the elementary surveys; however, the line of questioning was similar.

The surveys began with questions about career and college goals, along with parental careers. This was followed by course likes and dislikes, just like the elementary surveys. Specific detail was spent in the high school survey on the science and mathematics courses taken by the student and the effect they provided. Students were asked whether or not they felt the classes they had taken thus far had prepared them for work in their selected career. The conclusion of the high school survey included additional questions about engineering knowledge and opinions. The high school students were also asked whether or not any adult had ever suggested to them a career in engineering.

Procedure

The surveys were administered to the students by their teachers within their regular classrooms. For the elementary surveys, the students were given the surveys and the teachers remained available in order to assist the students in comprehension

of the questions if needed. The high school students were allowed one class session to complete their surveys and return them to their teacher for collection.

Chapter 4 – Results of Survey

All surveys were returned and reviewed for data analysis (this was a 100% response rate as surveys were administered and collected in one class period). Because the surveys were formatted with open-ended questions, each individual answer had to be subjectively evaluated in the context of the question. Data was organized using the five measures discussed in the previous chapter as a guideline. Results will be given in the following categories: career choices, academic enjoyment, math and science appreciation, and engineering knowledge. A summarization of all student answers can be found in Appendix E.

Career Choices

The students career aspirations ranged widely across a broad spectrum. See Table 3 (below) for a generic breakdown. Through all grade levels, the category of Scientific, Medical, and Technical careers was a large percentage of the selected professions, with medical positions such as doctor or nurse being most prevalent. A few selections showed a decrease as students aged. Sports/Performance and Farming

	Scientific, Medical, Technical	Sports, Performance	Law Enforcement, Military	Construction	Education	Farming	Other
3 rd Grade	5	3	1	0	0	3	4
6 th Grade	7	4	3	0	2	0	5
9 th Grade	9	2	3	1	2	0	4
12 th Grade	8	0	0	3	3	0	7

Table 3: Student Career Aspirations by Grade and Career Category

were often chosen in the younger grades, but declined through upper grades. Professions in the Law Enforcement/Military category showed no particular change as students aged. Two categories, Construction and Education, show no interest in younger grades but increased in the older grades.

As students get closer to graduating high school they put more thought into their future career. Their opinions change to more attainable, available, and successful careers. The selection of working as a professional athlete, actress/singer, or farming was not made by any of the students in their senior year, showing students' goals become more practical as the reality of the importance of their choice becomes clearer. Students were also less impressed by the opportunity of making money as they grew older. When asked why they selected their chosen careers, 20% to 30% of the students in the 3rd and 6th grades answered for reasons of money. This reasoning was not as prevalent in the 9th or 12th grade responses, decreasing to fewer than 10%.

Parent's careers also seem to play a significant role in career choices for their children, especially the younger the child. Of the sixteen 3rd grade students who completed the survey, seven selected careers similar to or exactly like the career of one of their parents. This decreased to three students in the 6th grade, two students in the 9th grade, and one student in the 12th grade. As the students get older they become more aware of the abundance of career options available to them, and often the career choice of their parents no longer seems as desirable.

When asked whether or not their selected career would require them to attend college, the answers also changed drastically across the age of the students. See

Figure 4 below. A majority of the 3rd grade students did not believe that they would need to attend college to achieve their current career goals. However, by 6th grade 80% of the students believed they would need a college degree. The 9th grade class increased this percentage to 90%, while 80% of the graduating seniors planned to attend college.

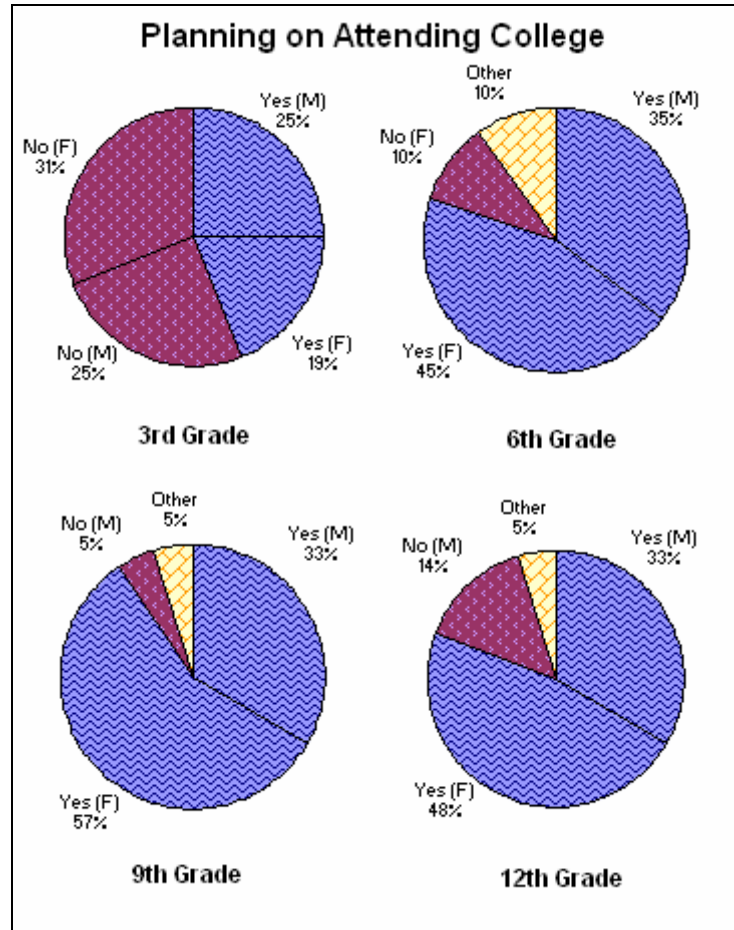


Figure 4: Percentage of Students Planning to Attend College

Academic Enjoyment

The surveys asked the students to provide their favorite and least favorite subjects. The answers given can be seen in Figures 5 and 6. While the favorite classes were given across a large range, the least favorite classes were often limited to

fewer choices showing the class was usually in agreement about the disdain for a certain subject. The students' answers for their favorite classes were Math and Gym in both the 3rd and 6th grades. By 9th and 12th grades the students' choices turned more toward English classes as this was the most commonly selected class by the 9th grade and tied for first in the 12th grade, while Math slid to third position in each.

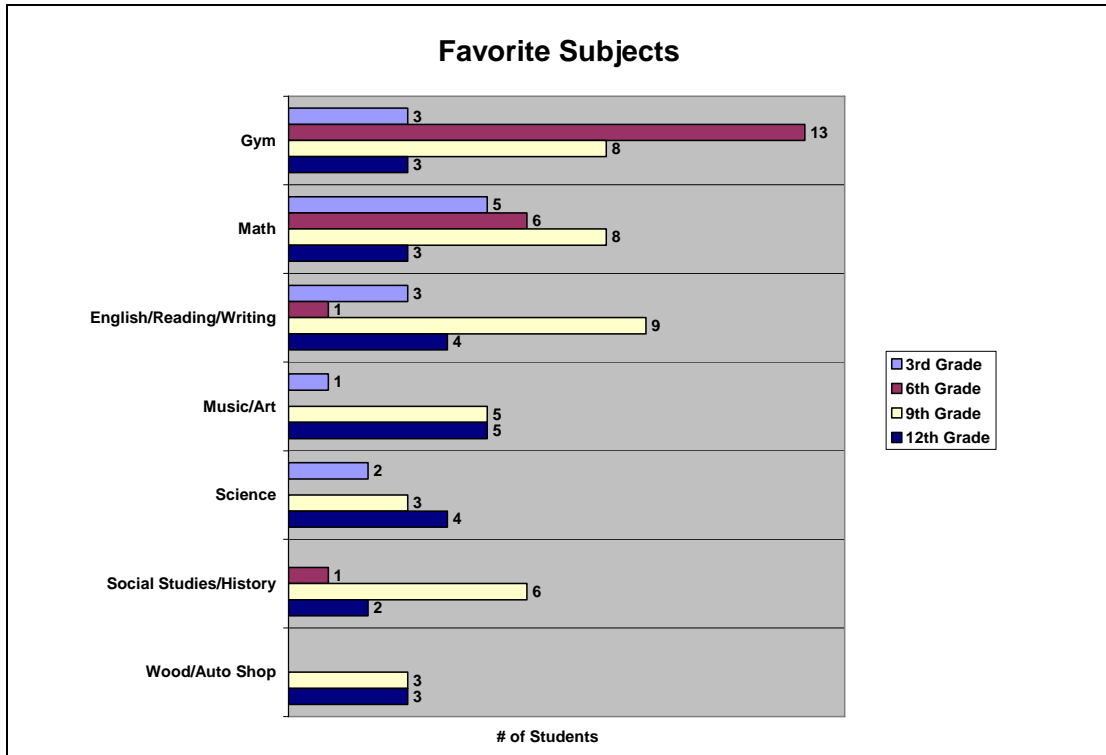


Figure 5: Subjects Students Enjoy Most Throughout their School Years

Science did not show any significant increases or decreases compared against student age. In the 3rd grade Science was third favorite along with Handwriting, however none of the students in the 6th grade selected science as a favorite class. The 9th grade class had Science in sixth place, but by their senior year the students had science ranked at first along with English. This suggests that the fondness of science is greatly dependant on the type of science being taught. For example, the 9th grade

class was not overly impressed with their Earth Science class (see Figure 6 below), while the seniors loved their Chemistry classes. The most commonly given reasons for selecting one subject over another as a favorite, were “I am good at it” followed by “it is fun”.

As mentioned above, Math was selected as the favorite subject by 31% of the 3rd graders, and continually decreased through 12th grade. Coincidentally, Math was also selected as least favorite by 31% of the 3rd grade class, coming in first place in this category as well. Math was selected as the second least favorite subject by the 6th and 9th grade classes, and noted second least favorite along with Health by the 12th graders.

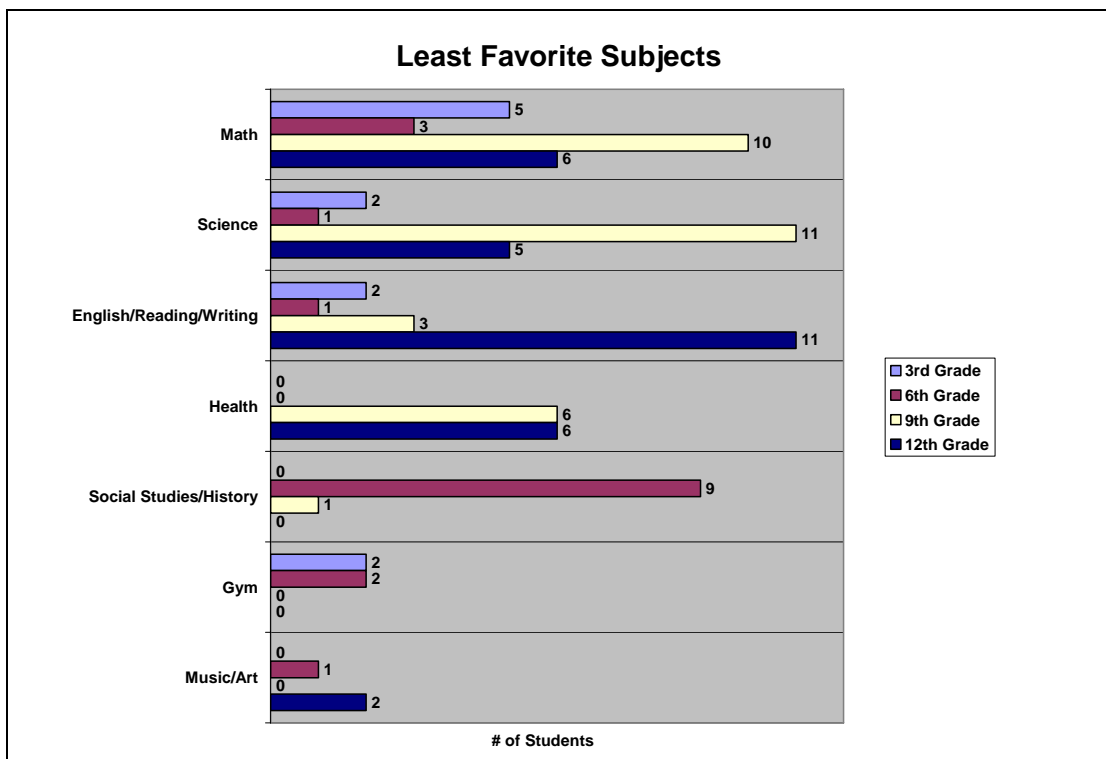


Figure 6: Subjects Students Dislike Most Throughout their School Years

Science was noted second most often as least favorite by the 3rd graders, and fourth by the 6th grade class. As mentioned above, the 9th grade class shows great disdain for Earth Science with 34% selecting Science as their least favorite subject. However, the 12th grade class places this subject as only their fourth least favorite class. The most commonly given reasons for selecting a subject as least favorite were “it is hard” or “boring”, and “I am not good at it”. Perception of how “good” a student is in any given subject is a great measure of how much that course is enjoyed by the student.

Math & Science Appreciation

In addition to describing their favorite and least favorite subjects, the students were also asked to state their feelings specifically about Math and Science. As these are critical courses for engineering and other technical careers. See Figures 7 and 8 (below) for a graphical representation of the student responses. It was found that the students’ feelings toward both Math and Science became increasingly negative the older the students grew. Acceptance of math declined from 75% in the 3rd grade, to 30% in the 12th grade. Not as drastic, but still poor was the acceptance of Science, which declined from 75% in the 3rd grade to 45% in the 12th grade.

A distinct separation was seen here between the sexes, and while this was not a stated measure of the survey, the result merits mention. As the students aged, decline in the acceptance of Math and Science was seen in both the male students and the female students. However, the male students showed a much more drastic decline. See Table 4 (below). Five of the eight male 3rd grade students stated they liked Math, but only one of the ten male 12th grade students said the same. While

seven of the eight female 3rd grade students stated they liked Math, this declined only to five of the eleven female 12th grade students. For Science, six of the eight male 3rd grade students stated they enjoyed the class; but this declined to three of the ten male students in the 12th grade. The females however stayed nearly even, changing from six of the eight 3rd grade students to seven of the eleven 12th graders.

		3 rd Grade	6 th Grade	9 th Grade	12 th Grade
Math	Male	5 / 8	5 / 10	3 / 8	1 / 10
	Female	7 / 8	7 / 11	6 / 13	5 / 11
Science	Male	6 / 8	4 / 10	6 / 8	3 / 10
	Female	6 / 8	9 / 11	5 / 13	7 / 11

Table 4: Male and Female Acceptance of Math & Science

The 9th and 12th grade classes were asked whether or not they felt the Math and Science classes they were currently taking, or had taken in the past, would prepare them for their future career choices. Nearly 40% of both classes felt they were prepared for their future career choices. Nearly 40% of both classes felt they were prepared for needed science skills. However, in 9th grade 50% of the students felt they were prepared with the required math needed for their selected career, and this number declined to 25% for the 12th grade students. While the decrease in the percentage is startling, the fact that only 40% of students feel they are prepared for the science that will be required of them, and as few as 25% feel they are prepared for math, is disappointing.

The best way to increase student learning and enjoyment of any school subject is to get the students involved in hands-on projects. The survey asked the 6th, 9th, and 12th grade students if their teachers had ever organized activities to keep math and

science lesson plans interesting and enjoyable. For math, 25% of the 6th grade students responded affirmatively. Of these, most students mentioned “M&M Math,” where they performed simple arithmetic calculations using M&M’s, which they then were allowed to eat. Another 25% of the 9th graders responded that they were allowed to do “fun, random stuff” and “played cribbage”. By 12th grade only one of the twenty-one students agreed that the teachers instituted fun activities in math courses.

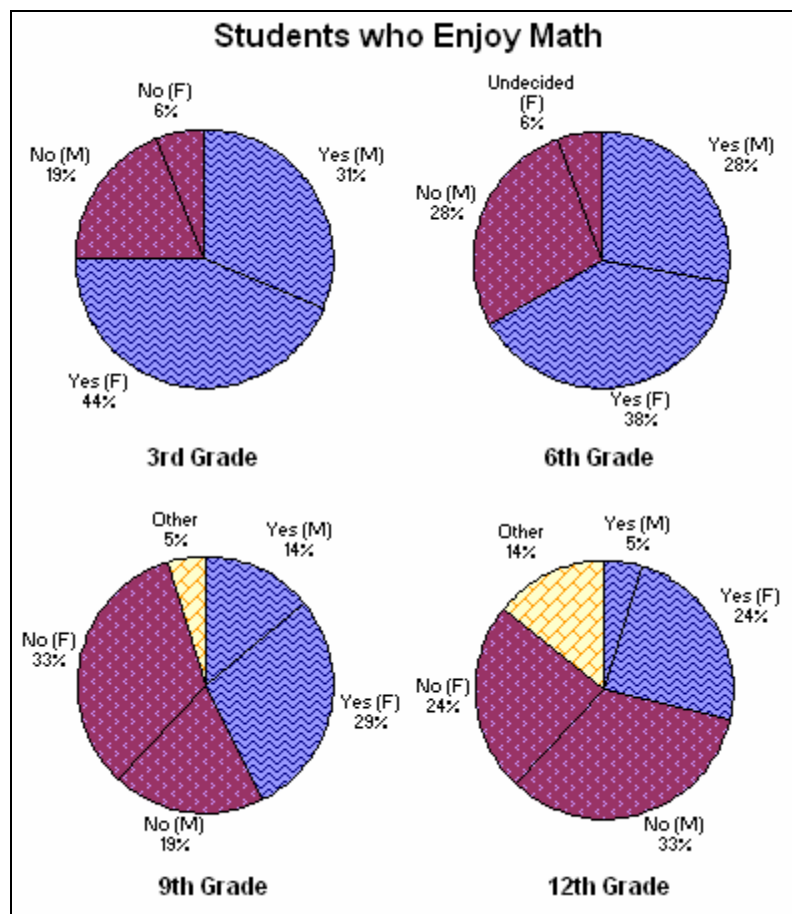


Figure 7: Percentage of Students Who Enjoy Math

Science offers a few more opportunities to perform interactive experiments and other projects; and this was consistent with the student responses. Nearly 40% of

the 6th graders mentioned activities like “hatching chicks,” “looking at cells,” and “field trips”. Over 50% of the 9th graders and 33% of the 12th graders responded that “labs” and “experiments” were sometimes performed. Many respondents agree that “there is definitely room for more” in-class activities.

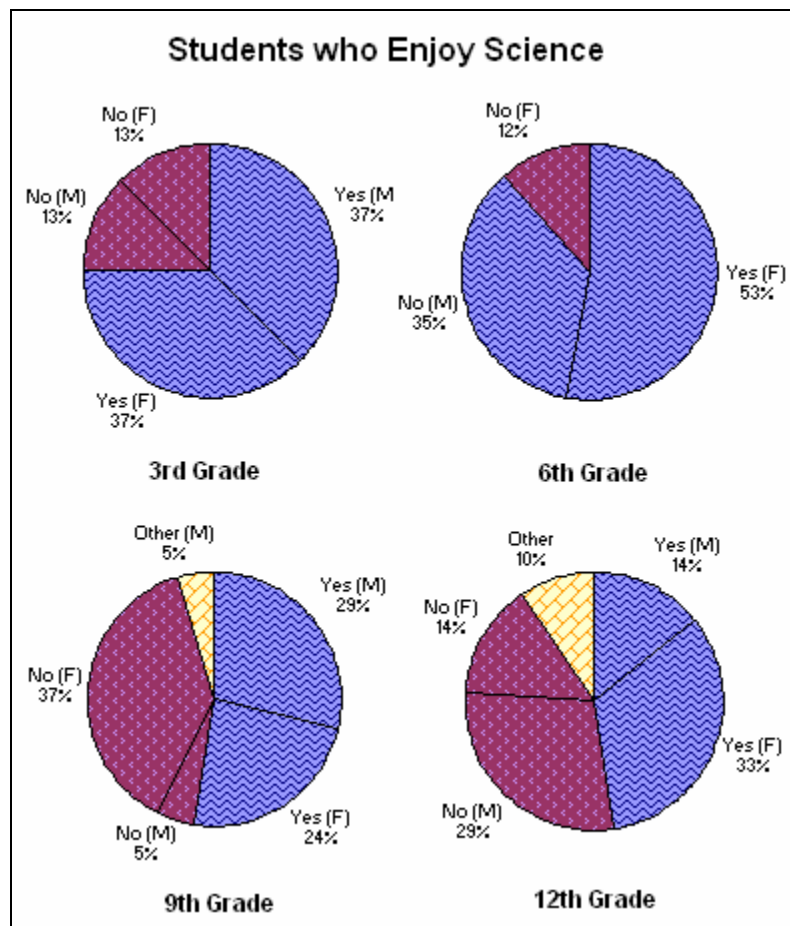


Figure 8: Percentage of Students Who Enjoy Science

In general, it was found that the students who stated that they didn’t like Math or Science also were among the students who did not think their teachers ever presented interesting activities. Use of such activities is the best way for teachers to spark a genuine interest in the subject being studied. Introducing engineering concepts to students through hands on activities, which will shed a positive light on

the technical aspects of the engineering career, can go a long way in changing the opinions of a student. As the next topic will show, this is growing more and more important.

Engineering Knowledge

A majority of the students at the subject school were unaware of engineering as a profession; in fact, many had never even heard of the word. As Table 5 (below) shows, only two of the 3rd grade students answered that they knew what an engineer does and in fact, both answered incorrectly. A larger portion of the 6th graders believed they knew what an engineer actually does, but of the eight students who thought this, only two were correct. The older students fared better. While only five of the twenty-one 9th graders responded affirmatively, four of these students were correct in their answers. Likewise nine of the senior students stated they knew what an engineer does, and seven of these nine were accurate. This shows that students are more correct in their assumptions of what engineering is as they get older, but it also confirms that sadly, only a small portion of students are aware of engineering at any age.

Most students when answering what they thought an engineer does answered around the idea of “fixes stuff”. While this was not entirely wrong, it was not counted as a correct answer for this survey. In nearly all cases, the students giving such an answer were referring to fixing cars, engines, and trains. Quite a few students replied that they believed this because of the word *engineer*, which they connected to the word *engine*. One 3rd grade student connected the word directly to a train engine, stating that an engineer is “someone who puts coal in the engine”. This phenomenon

was discussed previously in the Literature Review. In America, the word *engineer* is often connected to the word *engine*, rather than the original Latin word *ingeniator* from which it is actually derived. The surveys confirmed this to be the case.

	3 rd Grade	6 th Grade	9 th Grade	12 th Grade
Knows What an Engineer Does	2 / 16	8 / 21	5 / 21	9 / 21
Provided Correct Answer	0 / 2	2 / 8	4 / 5	7 / 9
Knows an Engineer	0 / 16	8 / 21	4 / 21	7 / 21
Has Had Someone Talk to Them About Engineering	N/A	N/A	4 / 21	6 / 21
Would Consider Engineering as a Career	N/A	2 / 21	5 / 21	1 / 21

Table 5: Student Knowledge About Engineering

As mentioned before, the location of the school where the surveys were administered is part of a very small town, in a largely rural area. The opportunities for engineering work are not great, thus it is understandable that a majority of the students do not know what an engineer does as they often do not personally know anyone who works as an engineer. From the survey responses, the actual number of students who do know an engineer is understandably similar to the number of students who stated they knew what an engineer does. However, when looking at which students gave these answers, they are often not the same students. In the 6th grade class only four students answered yes to both questions, in the 9th grade there was just one, and only five of the seniors responded this way. This shows that while students may know someone who works as an engineer, they seldom are provided a correct explanation as to what this profession entails.

In fact, very few of the students answered that anyone had ever spoken to them about the possibility of becoming an engineer. The older students were

specifically asked this question, and only roughly 25% of the students answered that someone in fact had discussed engineering with them. When asked if the students would ever consider engineering as a career, both the 6th and 12th grade students overwhelmingly stated no. The most common reason given was that they already knew what they wanted to do in the future. The 6th grade students were very attached to their chosen careers, and the seniors felt that it was already too late to make changes in their plans. The 9th grade class was more receptive with five of the twenty-one students stating they might consider engineering as a future career.

Excitement for Math, Science, and other technical courses must be initiated at a very young age. Students lose confidence in themselves as course work gets harder, and they lose patience in the lessons as the work becomes more technical and is viewed as less practical. Younger students demonstrate an enthusiasm for the coursework that keeps them engaged: science, math, and gym. Older students show enthusiasm in the subjects that they believe they are good at. If students remained engaged in the technical courses throughout their school years, they might show more warmth toward the subjects, and consequently the careers those subjects lead to, as they near college age.

Chapter 5 – Conclusions & Summary

Conclusions

The survey was successful in satisfying the five stated measures:

Measure 1

It was found that career choices evolve as student's age. Younger students choose professions of grandeur, to be a professional athlete, actress, singer, etc. They are more concerned with "making big bucks," or often select careers following their parents' footsteps. Older students opt for careers that closely match with their scholarly interests and talents, money is no longer as important, and the career of the parent is not as desired. The selection of engineering was rarely seen; in fact, only two of the seventy-nine students surveyed indicated a career in engineering.

Measure 2

The courses that students like and dislike vary from year to year. The subject being taught, the actual teacher, and the age of the student cause the selections to range far and wide. In fact, even within one grade level the same subject was selected as both *favorite* and *least favorite* by the same percentage of students. Reasoning given for liking a subject was most often that it was "fun," or that the student felt they were good at it. Reasoning given for liking a subject was the opposite. The class was "boring," or the student felt they were not good at it.

Measure 3

Students were asked specifically to state their feelings toward both Math and Science. It was assumed before the survey that a majority of the students would feel negatively toward these subjects. The survey found, however, that a majority of the younger students actually enjoy Math and Science. The percentage gets less and less the older the students become. While the percentage of students liking Math actually did become a minority by the 9th grade, the percentage of students liking Science never did. By the senior year, the number of students liking and disliking science was nearly even.

Most students felt that their teachers did not conduct interesting or stimulating activities in the class room to get them excited about these subjects and keep them interested. A number of students actually expressed their desire for more such activities.

Measure 4

The level of knowledge about engineering demonstrated by the students surveyed was very poor. Only thirteen of the seventy-nine students were able to correctly describe what an engineer does. Most students connect engineers to cars via the word engine, and a number placed engineers with trains through the same word. More than a few admitted they had never heard of the word engineer before completing the survey.

Measure 5

Completion of the surveys proved that student answers do change as they age. Their opinions on careers, their attitudes toward school, and their knowledge of engineering all varied across the studied classes. Sadly, many of the opinions change in ways that should be very worrisome for the engineering profession.

Summary

America is entering a crisis in the world of engineering. More engineers will be needed in the coming years than the engineering schools are able to graduate. In order to amend this problem action needs to be taken in the country's elementary and high schools. The study performed during this research proves this fact. As mentioned in the Literature Review, a number of outreach programs are already up and running around the country. More of these programs need to be implemented, and professional engineers, along with graduate and undergraduate engineering students need to get involved.

The best way to turn the problem around is to get actual engineers involved in exciting the minds of the American youth. Someone, somewhere, was instrumental in causing every American engineer to select engineering for their career. If these engineers can pass on their own enthusiasm to the youths in their cities, it will be a great start in planting the engineering seed in the minds of the next generation of engineers.

Recommendations for Additional Work

The survey administered during this research was simply a pilot survey to attain general opinions of elementary and high school students to see how student opinions change over time. In the future a more in depth study could be performed on the reasoning of student answers. It would be interesting to learn what suggestions students have for in-class activities that would keep them interested in both Math and Science courses. Also, the surveys here were given to four sets of students at different levels of their education. Following the same set of students as they grow older and evaluating changes in their responses to identical questions would provide interesting information.

This survey was administered to only one school in one rural town. The original idea of the survey was to compare the survey results between students in rural areas with students in metropolitan areas. A study of this magnitude could determine what effect environment has on students' knowledge of engineering. This could test the theory that students in rural areas do not have as many opportunities to become aware of the field of engineering and thus are not as aware of the options engineering offers to them.

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Appendix A – 3rd Grade Survey

The following two pages include the survey which was administered to the 3rd grade class at Laporte Public School in Laporte, MN.

The University of Kansas Edwards Campus

Engineering Management
Graduate Program

September 14, 2006

Dear Laporte School Student,

My name is Sara Roos. I used to be a student at Laporte School. I graduated in 1998.

Now I am grown up and I work as an engineer. I love my job. I am interested in what other students want to be when they grow up.

I know that there are not many other students like me that want to be engineers, and I want to learn why.

Would you help me with this project?

Behind this page is a list of questions about what you want to be when you grow up, what your favorite school subjects are, and how much you know about engineers. Please answer them as well as you can.

When you are done, please turn the sheet in to your teacher.

Thank you for your help! Good luck in the 3rd Grade!

A handwritten signature in black ink that reads "Sara Roos". The script is cursive and fluid, with the first letters of "Sara" and "Roos" being capitalized and prominent.

Sara Roos

SURVEY

Please answer the following questions.

Gender: Boy Girl (circle one)

1. What do you want to be when you grow up?
2. Why do you want to have that job?
3. Do you have to go to college to get that job?
4. What is your Mom's job?
5. What is your Dad's job?
6. What is your *favorite* subject in school? Why?
7. What is your *least favorite* subject in school? Why?
8. Do you like math? Why?
9. Do you like science? Why?
10. Do you know what an engineer is?
11. What do you think an engineer does?
12. Do you know anyone who is an engineer?

Thank you for helping me with my project!!

Appendix B – 6th Grade Survey

The following three pages include the survey which was administered to the 6th grade class at Laporte Public School in Laporte, MN.

The University of Kansas Edwards Campus

Engineering Management
Graduate Program

September 14, 2006

Dear Laporte School Student,

My name is Sara Roos. I am a former student of Laporte School, I graduated in 1998. Now I work as an engineer, and I love my job.

I know that there aren't many other students like me that want to be engineers, and I want to learn why.

Would you be willing to help me with this project?

Behind this page is a student survey. It includes questions about what you want to be when you grow up, what your favorite classes are in school, and how much you know about engineers. Please answer them as well as you can.

When you are done, please turn the survey in to your teacher.

Thank you for your help! Good luck in the 6th Grade!

A handwritten signature in black ink that reads "Sara Roos". The signature is written in a cursive, flowing style.

Sara Roos

SURVEY

Gender: Male _____ Female _____

Please answer the following questions.

1. What type of job do you want to get when you graduate from high school?
2. Do you need to go to college to get that job?
3. Why did you select that job?
4. What are your mother and father's jobs?
5. What is your *favorite* subject in school?

Why?

6. What is your *least favorite* subject in school?

Why?

7. Do you like math?

Why?

8. Have your teachers ever done interesting things in class to make math more fun?

What have they done?

9. Do you like science?

Why?

10. Have your teachers ever done interesting things in class to make science more fun?

What have they done?

11. Do you know anyone who is an engineer?

12. Do you know what an engineer does?

13. What do you think an engineer does?

Why do you think that?

14. Why would you or wouldn't you want to become an engineer?

Thank you for helping me with my project!!

Appendix C – 9th Grade Survey

The following four pages include the survey which was administered to the 9th grade class at Laporte Public School in Laporte, MN.

The University of Kansas Edwards Campus

Engineering Management
Graduate Program

September 14, 2006

Dear Laporte School Student,

My name is Sara Roos. I am a former student of Laporte School. I graduated back in 1998. I went on to college after high school and now I work as an engineer. I love my job. I know that there aren't many other students like me that want to be engineers, and I am interested in finding out why.

Would you be willing to help me with this project? Following this letter is a student survey. It includes questions about your career plans, feelings about different school courses, and your knowledge of engineers. Please answer them as well as you can.

When you are done, please turn the survey in to your teacher.

Thank you for your help and good luck in your freshman year!

A handwritten signature in black ink that reads "Sara Roos". The signature is written in a cursive, flowing style with a large, prominent "S" and "R".

Sara Roos

SURVEY

Gender: Male _____ Female _____

Please answer the following questions.

1. Are you planning on going to college after you graduate?

If yes, what will your major be?

If no, what will you do after graduation?

2. What would you like your career to be in the future?

3. Why did you select that career?

4. What is your mother's career? What is your father's career?

5. What are your *favorite* classes you are currently enrolled in?

Why are they your favorite?

6. What are your *least favorite* classes you are currently enrolled in?

Why are they your least favorite?

7. How do you feel about mathematics?

Why do you feel that way?

8. What is the highest mathematics class you have completed?

How did you feel about that class?

9. Are you taking a mathematics class this semester and what is it called?

How do you feel about this class?

10. Do your teachers organize fun activities to keep math interesting and enjoyable?
If so, what?

11. Do you feel the mathematics classes you plan to take in high school will prepare you for your future career choice?

12. How do you feel about science?

Why do you feel that way?

13. What is the highest science class you have completed?

How did you feel about that class?

14. Are you taking a science class this semester and what is it called?

How do you feel about this class?

15. Do your teachers organize fun experiments and activities to keep science interesting? If so, what?

16. Do you feel the science classes you plan to take in high school will prepare you for your future career choice?

17. Do you know anyone who is an engineer?

18. Do you know what an engineer does?

19. What do you think an engineer does?

Why do you think that?

20. Has anyone ever talked to you about becoming an engineer?

21. Why would you or wouldn't you think about becoming an engineer?

22. What is your impression of the work load involved in completing an engineering degree in college compared to any other degree?

23. What is your impression of the wages paid to engineers compared to other professions?

Thank you for helping me with this project!!

Appendix D – 12th Grade Survey

The following four pages include the survey which was administered to the 12th grade class at Laporte Public School in Laporte, MN.

The University of Kansas Edwards Campus

Engineering Management
Graduate Program

September 14, 2006

Dear Laporte School Student,

My name is Sara Roos. I am a former student of Laporte School. I graduated back in 1998. I went on to college after high school, and now I work as an engineer. I love my job, but I know that there aren't many other students like me that want to be engineers. I am interested in finding out why.

Would you be willing to help me with this project? Following this letter is a student survey. It includes questions about your career plans, feelings about different school courses, and your knowledge of engineers. Please answer them as well as you can.

When you are done, please turn the survey in to your teacher.

Thank you for your help and good luck in your senior year!

A handwritten signature in black ink that reads "Sara Roos". The signature is written in a cursive, flowing style.

Sara Roos

SURVEY

Gender: Male _____ Female _____

Please answer the following questions.

1. Are you planning on going to college after you graduate?

If yes, what will your major be?

If no, what will you do after graduation?

2. What would you like your career to be in the future?

3. Why did you select that career?

4. What is your mother's profession? What is your father's profession?

5. What are your *favorite* classes you are currently enrolled in?

Why are they your favorite?

6. What are your *least favorite* classes you are currently enrolled in?

Why are they your least favorite?

7. How do you feel about mathematics?

Why do you feel that way?

8. What is the highest mathematics class you have completed?

How did you feel about that class?

9. Are you taking a mathematics class this semester and what is it called?

How do you feel about this class?

10. Do your teachers organize fun activities to keep math interesting and enjoyable?
If so, what?

11. Do you feel the mathematics classes you have taken in high school have prepared you for your future career choice?

12. How do you feel about science?

Why do you feel that way?

13. What is the highest science class you have completed?

How did you feel about that class?

14. Are you taking a science class this semester and what is it called?

How do you feel about this class?

15. Do your teachers organize fun experiments and activities to keep science interesting? If so, what?

16. Do you feel the science classes you have taken in high school have prepared you for your future career choice?

17. Do you know anyone who is an engineer?

18. Do you know what an engineer does?

19. What do you think an engineer does?

Why do you think that?

20. Has anyone ever talked to you about becoming an engineer?

21. Why would you or wouldn't you think about becoming an engineer?

22. What is your impression of the work load involved in completing an engineering degree in college compared to any other degree?

23. What is your impression of the wages paid to engineers compared to other professions?

Thank you for helping me with this project!!

Appendix E – Survey Results

The following ten pages include student answers a sampling of questions from the surveys.

Student Answers to a Sampling of Survey Questions - 3rd Grade

	Boy/Girl	What do you want to be when you grow up?	Why do you want to have that job?	What is your <i>favorite</i> subject?	Why?	What is your <i>least favorite</i> subject?	Why?
1	Boy	Army Officer	I like guns.	Gym	Get to play soccer.	Writing.	I'm not good at it.
2	Boy	Racecar driver, ocean fisherman	I like those things.	Adios	Get to go home.	Don't have one.	no answer given
3	Boy	Bartender	My dad likes it.	Gym	Because you get exercise and it is fun.	Math.	Because I don't like it.
4	Boy	Doctor	My mom is a doctor.	Handwriting	I want to learn to write really good.	Math.	It is hard.
5	Boy	Salesman	My dad is.	Science	It is fun.	no answer given	no answer given
6	Boy	Rancher	I like horses.	Math	I like to add.	no answer given	no answer given
7	Boy	Doctor	My mom is a nurse.	Math	It is all about numbers.	Science	It is all about reading.
8	Boy	Famous football player	You get millions of dollars.	Recess	No work, you get to play.	Math.	You have to work.
9	Girl	Horse rider, rancher	no answer given	Science	It is fun.	Math.	It is not fun.
10	Girl	Veterinarian	I get money to help my family, and I like animals.	Art	It is fun.	Gym	It hurts my side.
11	Girl	Singer and Dancer	I practice a lot.	Handwriting	It is fun to write.	Story Time	You need to sit.
12	Girl	Ocean Fisherman	I like fishing.	Gym	I like it.	no answer given	no answer given
13	Girl	Veterinarian	I love animals.	Math	I love to learn.	None	I love them all.
14	Girl	Rancher	I like ranches.	Math	I love to learn.	Science	It is hard.
15	Girl	Actress	To be famous.	Math	Challenging.	Gym	You have to run laps.
16	Girl	Veterinarian	I love animals.	Spelling	I am good at it.	Math.	It is hard.

Student Answers to a Sampling of Survey Questions - 3rd Grade - Continued

	Do you like math?	Why?	Do you like science?	Why?	What do you think an engineer does?
1	Yes	I'm good at it.	Yes	We get to hatch eggs and do research.	Fixes cars.
2	Yes	It's challenging.	Yes	Get to learn a lot.	Someone who puts coal in the engine.
3	No	I don't like it.	Yes	I like it.	Build stuff.
4	No	It is boring.	No	It is hard to understand.	I don't know.
5	Yes	It is fun.	Yes	It is fun.	I don't know.
6	Yes	I like to add.	Yes	I like to learn.	I don't know.
7	Yes	It is all about numbers.	No	It is all about reading.	Drives a train.
8	No	You have to work.	Yes	You get to crack open eggs.	Builds stuff.
9	Yes	You don't get to do much.	Yes	It is my favorite, it is fun.	I don't know.
10	Yes	It is challenging.	Yes	It is fun.	Makes machines.
11	Yes	It is challenging.	Yes	It is fun.	Fixes things.
12	Yes	I like it.	Yes	I like it.	I don't know.
13	Yes	I love to learn.	Yes	It is my second favorite.	It is someone who is drunk.
14	Yes	It is fun to learn.	No	It is hard.	I don't know.
15	Yes	It is fun.	No	It is not fun.	Fixes stuff.
16	No	It is hard.	Yes	You get to learn stuff.	no answer given

Student Answers to a Sampling of Survey Questions - 6th Grade

	Male / Female	What type of job do you want to have in the future?	Why did you select that job?	What is your <i>favorite</i> subject?	Why?	What is your <i>least favorite</i> subject?	Why?
1	Male	Make & Sell Computers	Make big bucks.	Gym	It's fun.	Math	It's hard.
2	Male	Police Officer	My dad wanted to be one.	Social Studies	The history.	Science	Too much looking stuff up.
3	Male	no answer given	no answer given	Gym	Dodge ball	Social Studies	It's boring.
4	Male	Chiropractor	They get money.	Math	It is easy.	Social Studies	It is hard.
5	Male	Military	My whole family was in the military.	Gym	It is fun.	Social Studies	It is boring.
6	Male	Army soldier	Tons of benefits, it would feel good to serve your country.	Gym	No homework, it is fun.	I like them all	no answer given
7	Male	Pro Paintballer	I like to get in wars.	Gym	I like to run.	Reading	I don't like to read.
8	Male	Basketball	I am good at it and I enjoy it.	Gym	Basketball	Social Studies	I don't need to know it
9	Male	I don't know	I don't know.	Lunch	Food	Everything else	It's boring.
10	Male	Video game designer	I like video games.	Gym/Math	It is fun.	no answer given	no answer given
11	Female	Photographer	I am passionate about it.	Music	It is interesting.	I don't have one.	School is fun.
12	Female	Teacher	My mom is going to be a teacher.	Gym	I get to run around.	Social Studies	It is boring.
13	Female	Babysitter	I love kids.	Math	It is fun.	Music	I don't like music.
14	Female	Veterinarian	I love animals.	Gym	You get to run around and have fun.	Social Studies	I don't like it.
15	Female	Doctor	It would be fun. I would make a lot of money.	Math	It is fun.	Gym	It is boring.
16	Female	Cashier at Wal-Mart	I like to do what cashiers do.	Gym	You can move.	Social Studies	I don't like memorizing stuff.
17	Female	Professional Hockey or Soccer player	I am very good at these sports.	Gym/Math	I like sports, and I am good at math.	Social Studies	Read lots of boring books.
18	Female	Singer and Lawyer	I like to sing and I like to argue.	Reading	I love to read.	Social Studies	It is boring.
19	Female	Marine Biologist	I love the water and I want to help the sea animals from the pollution.	Gym	I like to keep moving and have fun.	Math	I am not so good at it.
20	Female	Nurse or Doctor	A lot of money.	Gym	Running and practice for volleyball.	Math	Too much writing.
21	Female	Therapist	I like it, I think it makes good money.	Math	I like to add.	Gym	I'm not good at it.

Student Answers to a Sampling of Survey Questions - 6th Grade - Continued

	Do you like math?	Why?	Do you like science?	Why?	What do you think an engineer does & Why do you think that?	Why would you or wouldn't you want to become an engineer?
1	No.	It's hard.	No	Hard work.	No idea. I have never heard of the word.	No. It sounds hard.
2	Yes	Learn to do stuff like adding etc.	No	Just too much looking stuff up.	Fixes stuff. Because engineers - engine.	I wouldn't mind becoming an engineer.
3	No	It's boring.	No	I don't know.	no answer given	I don't know.
4	Yes	It is easy.	Yes	It's fun.	Fixes stuff.	I don't want to be.
5	No	It is boring.	No	It's boring.	Fixes engines.	I am going into the military.
6	Yes	It is easy.	Yes	It is fun to work with chemicals and look in the microscope.	Work on engines. Because of the word engineer.	I don't know.
7	No	I don't like to add	Yes	I like to mess with stuff.	Works on motors.	I wouldn't.
8	Yes	I am good at it.	Yes	It's fun.	They engineer	No. I like basketball.
9	No	It's boring.	No	It's boring.	I don't know.	no answer given
10	Yes	It's fun.	No	no answer given	Repair stuff.	No
11	Yes	My teacher rocks.	Yes	My teacher rocks.	Fixes machines.	I don't know what it is.
12	Yes	It is the same in every school.	Yes	I get to look at cells.	no answer given	No, I would rather work with kids.
13	Yes	It is fun.	No	It is hard.	Works on trains and planes.	No, I would rather work with kids.
14	Yes/No	Yes when it is easy, no when it is hard.	No	I don't know.	I don't know.	No. I want to be a vet.
15	Yes	I like math problems.	Yes	It is fun to learn about planets.	Fixes cars. Because of the word engineer.	Because you have to get dirty.
16	Yes	I Like to add, multiply, divide and subtract.	Yes	It is interesting.	Makes things.	No. I want to be a cashier at Wal-Mart.
17	Yes	I am good at it.	Yes	It is fun.	They plan out and design systems.	I would like to become an engineer because I am smart and would be good at it.
18	No	I don't get it, it is hard for me.	Yes	You get to learn about animals.	no answer given	I don't know what an engineer does.
19	No	I am not so good at it.	Yes	We get to look into microscopes and it's cool.	They fix engines and invent stuff.	No. Cause it pollutes the earth in some sort of way.
20	No	Too much writing.	Yes	We are looking at cells.	no answer given	No it sounds hard.
21	Yes	I like to add.	Yes	It is interesting.	I don't know.	no answer given

Student Answers to a Sampling of Survey Questions - 9th Grade

	Male / Female	What would you like your career to be in the future?	Why did you select that career?	What are your <i>favorite</i> classes?	Why are they your favorite?
1	Male	Electrician	It is fun.	Gym	Physical activity.
2	Male	Lawyer	To be a lawyer.	Math, History	Good teachers.
3	Male	Computer programmer for a gaming company.	Because I have fun doing it.	Shop and Computers	I like to work with wood and computers.
4	Male	no answer given	no answer given	Gym	No school work.
5	Male	Football player	It is what I'm good at.	Gym, English, Social Studies	They are easy.
6	Male	Military	I always wanted to be one.	World History, English	I like what we do in the classes.
7	Male	Forest management, Engineer	Because it has to do with my interests.	Gym, Math, Science, Shop	I enjoy them and they come easy. I like learning new things.
8	Male	Cop or a lineman	It's just what I'm into.	Shop, World History, Science	I can use my hands, hands on.
9	Female	Photographer.	I love taking pictures.	Art, Gym	I love drawings, and I get to run around.
10	Female	Elementary Teacher	I've been interested in it since I was little.	Math, English, Gym, Lunch, Social Studies	I like they classes.
11	Female	RN or Crime Scene Investigator.	Because I'm interested in that kind of stuff.	Algebra, Science	Because I enjoy doing it. I like the challenges.
12	Female	I'm not sure.	no answer given	Algebra	It is easy for me to understand.
13	Female	Physical therapist.	Because I like to help people and it would just be a fun job.	History, Wellness, Child Development, English	They are easy and interesting.
14	Female	World history or art teacher.	Teenagers start to look for what they want to be when they grow up and I want to be a part of their decision for the future.	World History, Art	Because I want to be a world history or art teacher.
15	Female	Some kind of nurse.	Because my aunt is a nurse and I always wanted to help people.	Math, English	I am good at reading and spelling, and I am good at algebra.
16	Female	Some kind of engineer.	I don't know why, maybe because I am smart.	Math, English	I am really good at it.
17	Female	Speech Therapy	Because I like to help people and be around them.	Art, Gym	Because I like to be creative.
18	Female	Veterinarian and Graphic design artist.	It appeals most to me.	English	It has the most freedom and choice.
19	Female	Actor, or equine study.	Because I like acting, I also love working with horses.	Gym, World History, English	The teachers make learning fun.
20	Female	Vet assistant, maybe even a vet.	I love animals, and want to help them.	English, Math, Art	They are some of the fun classes.
21	Female	Cop	Because I think I would enjoy it.	Art, Child Development	Because the teachers are cool and the class is fun.

Student Answers to a Sampling of Survey Questions - 9th Grade - Continued

	What are your <i>least favorite</i> classes?	Why are they your least favorite?	How do you feel about mathematics?	Why do you feel that way?
1	Math, Physical Science	They are dumb.	It sucks.	Cause I do.
2	English	Boring.	Fine.	I don't know.
3	History	I don't find it interesting.	OK.	It's not fun, but you need it to be a programmer.
4	Math, Science	Teachers.	no answer given	no answer given
5	Math, Wellness, Science	Worst subjects.	Frustrated.	I don't get algebra.
6	Math	I don't like it.	I feel that I should improve on it.	I'm not that good.
7	English	I'm not a fan of writing.	I like it.	Because it is interesting and fun and easy.
8	Math.	I don't get it all the time.	I don't care for it.	I don't get it sometimes.
9	Math, Child Development	The teachers pile on the work all the time.	I am not too fond of it.	Too much work.
10	Science	It is kind of fun, but not like the others.	I like it.	I am good at it.
11	English	no answer given	I love math.	no answer given
12	Wellness	It doesn't really matter to me.	I love it.	I understand it.
13	Math, Science	Because they are confusing and a lot of work.	I'm not crazy about it.	Because it is hard.
14	I don't have one.	no answer given	I feel they are amusing and confusing.	It's so weird how everything can have something to do with math and even though it's hard, it's fun. I like it.
15	Science	I can never understand what we are talking about.	Math is fun and I enjoy it.	I'm good at it and I like working big problems and I like numbers.
16	Science	Science has been hard for me sometimes and I don't get it half of the time.	Math is fun and I enjoy it.	I am good at math for one, and I like numbers.
17	Math, Science	Because I am not good at them.	I'm not good at it.	I've never been good at math.
18	The rest.	They make no sense.	Bad.	A bit of math is fine, but this is extensive.
19	Science, Math, Child Development	Because they do not make it fun.	I don't like it.	It is boring.
20	Wellness, Child Development, Science	Because the teachers aren't making us want to learn it, they are kind of boring.	OK.	Because I am getting better at it.
21	Science, Math	Because the classes are boring and I hate doing math.	Don't enjoy it.	Because it's dumb.

Student Answers to a Sampling of Survey Questions - 9th Grade - Continued

	How do you feel about science?	Why do you feel that way?	What do you think an engineer does & Why do you think that?	Why would you or wouldn't you think about becoming an engineer?
1	It sucks.	Cause it does.	I don't care.	no answer given
2	Good.	You get to touch stuff.	Solve things, build stuff.	I'm not sure.
3	Fine.	It is not that interesting.	no answer given	no answer given
4	no answer given	no answer given	no answer given	no answer given
5	Good.	It's usually fun.	Works with engines. Engineer - engine.	Never really thought about it.
6	It's ok.	The work is not too hard.	I don't know.	I would to make money.
7	I like it, fun, new technologies.	Because it is neat what people can think up.	Makes and designs things. I have read about them.	Yes. Because they use mathematics and science. Things I am good at.
8	Love it.	A lot of experiments.	Not sure.	I might like it.
9	It's alright.	I like it when we actually do labs and activities.	I don't know.	Because I don't even know what they are.
10	Don't like it.	It is boring.	Fixing stuff. It sounds like it.	It doesn't sound right for me.
11	It's sometimes confusing, but I like it.	no answer given	Not really sure.	no answer given
12	I love it.	I'm not sure.	no answer given	It seems fun, and I like math and science.
13	I'm not too fond of it.	Because I just don't. It is confusing,	I don't know.	I wouldn't even know because I don't know what it is.
14	Fun.	Because I like seeing how the world is working and I love being in the science fair.	Conducts a train.	Because I know I want to be a teacher.
15	I don't really like it.	I am bad a science.	Solves problems.	I don't like problems.
16	I don't like it.	I am bad at science.	Solves problems.	I am good at solving problems, and I'm currently the smartest person in my class.
17	It's good to know.	Because if you are majoring to be a biologist you should know it.	Something to do with trains.	I don't know. It doesn't seem interesting.
18	Mixed.	Science is the most useful of all four subjects, but it is not good.	Builds. From TV.	Never.
19	I don't like it.	The class is boring, I want to learn about animals.	Trains, cars? Because of the word engineer.	Because I want to stay in animal medicine and equine study.
20	Not very good.	It's boring.	I don't know.	I have always wanted to be a vet and that will never change.
21	It's fun sometimes, but other than that it's dumb.	Because who needs science. Not me.	I don't know.	Doesn't sound like something I would be interested in.

Student Answers to a Sampling of Survey Questions - 12th Grade

	Male / Female	What would you like your career to be in the future?	Why did you select that career?	What are your <i>favorite</i> classes?	Why are they your favorite?
1	Male	no answer given	no answer given	Native American History	no answer given
2	Male	Have my own auto repair shop.	I'm interested in it.	Shop	No class work like books and stuff.
3	Male	To own and manage a movie theater.	Movies are my passion and there's money to be made.	Math, Science	I love working with scientific theories and numbers.
4	Male	Don't know.	no answer given	Study Hall	Don't have to do anything.
5	Male	no answer given	no answer given	Study Hall	Don't have to do anything.
6	Male	Construction and play in a band.	It's what I'm good at.	Band, Science	I like music.
7	Male	Carpenter	I like to work with my hands.	Construction Trades	Prepares me to be a carpenter.
8	Male	General practitioner.	I think it would be something that I would enjoy.	Chemistry, Economics	I enjoy them because I'm usually good at them.
9	Male	Physical Education Teacher	It would be fun to play with kids.	Art, Gym	I get to show creativeness and run around.
10	Male	Construction	Good money.	Shop	Get to work on stuff.
11	Female	Massage therapist and Psychologist	I love to give massages and help people solve problems.	English, Spanish, Gym, Peer Tutoring	I love to write, speak Spanish, get fit, and I love kids.
12	Female	Daycare worker.	I love working with kids.	Library, Choir	Because I can sing, and I like working in the library.
13	Female	A doctor.	I like helping people.	English	I like to read.
14	Female	History Teacher	I like history.	History, Auto Repair	I like history, and I like cars.
15	Female	RN.	I love to help people.	Math, Art	I like art because they are your own ideas. Math you have to figure out the problem.
16	Female	Vet or pediatrician	Because I love to work with animals and kids.	Gym, Geometry	Because I enjoy them.
17	Female	no answer given	no answer given	no answer given	no answer given
18	Female	I don't know.	no answer given	None	no answer given
19	Female	no answer given	no answer given	no answer given	no answer given
20	Female	Psychologist	Because I want to better understand people.	Art, Economics, English	Because they come easy to me.
21	Female	Forensic Scientist	I love science and I love forensics.	Chemistry, English	They interest me.

Student Answers to a Sampling of Survey Questions - 12th Grade - Continued

	What are your <i>least favorite</i> classes?	Why are they your least favorite?	How do you feel about mathematics?	Why do you feel that way?
1	Science, English	no answer given	no answer given	no answer given
2	Art	I'm not very artistic.	no answer given	no answer given
3	English	I love to write, but I can't spell.	Everyone needs to learn some portion of math. It is used everyday.	I love math, I'm not sure why.
4	Math, English, Band, Health	Don't like them.	Hate it.	It's hard.
5	Math, English, Band, Health	It is hard.	It's hard.	It's hard.
6	English	Boring	Not good at it.	Because I'm not good at it.
7	English	Too quiet.	Hate it.	Too hard.
8	Pre-Calculus, and Spanish	They are harder for me to understand.	I'm usually not a big fan of math.	Math is hard for me so it isn't a whole lot of fun. I can do it but I have to work at it.
9	Chemistry, English	Don't understand them.	Not a big fan.	Teachers.
10	English	Don't like writing and reading.	It's hard.	Have trouble understanding it.
11	Accounting, Woods, Geometry	Boring.	Complicating.	Just do.
12	Health	It's hard work.	I don't like it.	It's too confusing.
13	Health, Chemistry, Pre-Calc	The teachers.	I like it, depends on the teacher.	I like calculating stuff.
14	English, Pre-Calc	Too boring, too repetitive.	I'm good at it, but don't necessarily like it.	Too repetitive.
15	English	I'm just not good at it.	I love it.	Because I like figuring out problems.
16	Chemistry, Art	Because I don't enjoy doing them.	It's ok.	Because sometimes I don't get it.
17	no answer given	no answer given	Don't like it.	no answer given
18	English, Shop, Health	They bore me.	I kind of like math.	It's easy for me.
19	no answer given	no answer given	no answer given	no answer given
20	Chemistry	Because it involves math.	I hate it.	Because it is too hard.
21	Health, Spanish	The teacher is boring.	I'm good at it.	I don't enjoy it.

Student Answers to a Sampling of Survey Questions - 12th Grade - Continued

	How do you feel about science?	Why do you feel that way?	What do you think an engineer does & Why do you think that?	Why would you or wouldn't you think about becoming an engineer?
1	no answer given	no answer given	no answer given	no answer given
2	I don't like it.	no answer given	Designs and makes new stuff.	If they come up with new stuff, I can't do that.
3	It's hard.	I can't seem to wrap my head around everything.	Solve problems.	I like solving problems and I am resourceful.
4	Don't like it.	It's hard.	Builds things.	Because I don't want to.
5	Don't like it.	no answer given	no answer given	Don't know what it is.
6	Good.	Science is interesting.	Fixes stuff.	Because I already have a plan for my life.
7	Boring.	Only when we don't do experiments.	Builds things, creates stuff.	I have other goals.
8	I like science.	It is interesting to me.	I would guess that they design things.	From the questions you asked, it seems like tons of math is involved.
9	It's fun.	I like to experiment.	Works on vehicles.	Because I would rather be working with kids.
10	It's hard.	It's just like math, can't understand.	Build things, make things better.	Going to college isn't for me.
11	It's okay - but it confuses me a little bit.	Not a big fan or science I guess.	Fixes machinery and produces parts for certain products.	I wouldn't because I already have a career plan.
12	I do not like it.	It's too hard for me.	I think it works with cars. Because of the word engineer.	I would not think of it because I like working with kids.
13	It's ok.	I think it could be more enjoyable.	They design certain things.	Probably not.
14	Ick.	Too much to remember.	Creates new ways to get things done or more efficient ways.	Too much seriousness, not much fun.
15	I like it.	Not all science I like, but I love Biology.	Puts things together and creates things.	I have no idea.
16	Not my favorite.	Because I don't understand what the teachers trying to teach me.	...engineers things.	No, because I don't know what they do.
17	It's ok.	no answer given	Something to do with engines. Because engine - engineer.	No, because I already know what I want to do.
18	It's ok.	Some of it interests me, some of it doesn't.	Fixes stuff, works on stuff. I see them in movies.	I would not think about it.
19	no answer given	no answer given	no answer given	no answer given
20	I like it.	Because it is interesting.	I don't know.	I wouldn't, because I'm pretty sure it involves a lot of math.
21	I love it.	Because fact has always interested me and that is what science is.	They figure things out, like building a bridge and making it strong.	I don't like math as much as science.